Sullivan County Cooperative Extension Service

24 Main Street
Newport, NH 03773

John Cressy, Facilities Director

Energy Audit Report

This Historic Building was built in 1948 as the Sullivan County Registry of Deeds and is now used as the offices for the New Hampshire Extension Services for UNH in Sullivan County. It is listed on the National Registry of Historic Places.

West facing entry way view

The construction consists of a concrete foundation and basement with brick and block exterior walls, poured concrete floors and a copper roof. The condition is very good as it is well built and has been maintained.

The building is three stories with a low ceiling basement of about four foot clearance, containing an oil fired hot water heating boiler, an electric hot water storage tank and two 275 gallon oil tanks. The first floor has a central hallway with 3 offices, conference room and open stairway. The second floor has 5 offices and a conference room and the third floor has 2 storage rooms.

Front door with added aluminum frame and glass storm door

Basement: The concrete basement area contains the oil fired boiler, replacing a steam boiler around 1990.   The Cast Iron boiler (name tag and data plate is missing) is fired at 1.75 gph on oil, which would provide a heating capacity of around a net 196,000 BTU/Hr. The replacement boiler piping was connected to some of the 2 ½" steel steam piping and reduced to 2 inch diameter copper and is circulated with old style three piece circulator pump to baseboard (Sterling Senior baseboard) in a mono-flow piping arrangement, with some changes that were added and piped in series. The system does have an old style bulb and capillary White Rogers Outdoor Reset Control, which is set at #2 setting with the chart tells us that at 0F the water temperature is 140F and at -20F the water temperature is 160F. I question if this control is still working or connected to the system, but a modern Outdoor Reset Control in operating condition and a properly adjusted reset curve should be used with this type of baseboard heating system.

Many of the office spaces have a thermostatic radiator valves (TRV) for individual room temperature control, but staff feels that they do not provide good control and comfort. The TRV's are located in the baseboard enclosure and can be difficult to reach and they also have a built in temperature stop that limits the ability to adjust them within the desired comfort setting. Additionally many of the baseboards have desks and office furniture blocking the free travel of air through the baseboard convector reducing operating efficiency. I did not have opportunity to check each of these TRV's for proper operation as it the physical inspection was done on very warm summer days.

The boiler is equipped with a low water cut off as required, but the oil tanks do not have oil safety valves to prevent gravity draining in the event of an oil supply line failure. Since this space is not people friendly for easy accessibility a large quantity oil heating oil could be dumped before it is discovered. The twin oil tanks, I estimate to be circa 1990, and installed along with the current boiler, are the old side tap style tanks that always leave a layer of water on the tank bottom and can rust out and leak over time.

The boiler area does have a mechanical fan installed in 10"x 2 ¼" duct work to provide outside combustion air to the space, but this fan is a residential vent fan, around 20 years old, which would be near the end of its useful life.

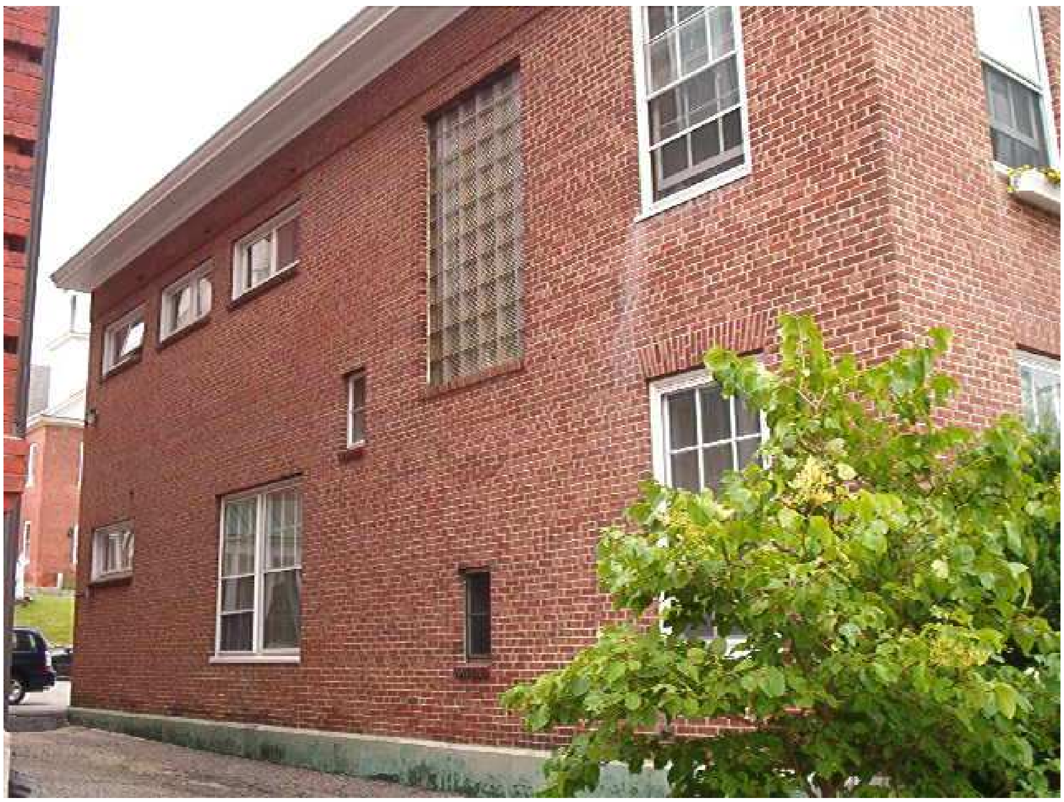
The smoke pipe from the boiler travels horizontally about 10 feet and through a concreted wall, into an offset block chimney base, then crosses up and over to the adjacent brick chimney. The metal elbow has come apart inside this block base and needs to be replaced, if this boiler is to be used for the upcoming heating season.

My recommendation for the heating system would be replacement with an LP gas, condensating boiler that is set up for sealed combustion and has outdoor reset control. This would solve the issues with proper combustion air, chimney, oil storage tanks and outdoor reset control upgrade. Your current combustion efficiency is around 80% and LP condensating boiler efficiencies are in the 92%+ range. The distribution system would also be more efficient when piped with a home run style of hot water supply piping, to deliver the hot water via insulated lines (PEX pipe would be great for this application) to the TRV controlled zones.

The basement also has six areas where vented louvers penetrate the concrete wall for outside air to circulate. This outdated strategy is not used these days, as warm moist air will enter and condense on cool surfaces in the basement, sometimes leading to moisture issues. Additionally these louvers are not maintained and in operation and result in cold winter air entering the basement. Occupant complaints about a cold first floor rest room can be believed due to this open vent and riser under the corner rest room. Risers for piping from the basement to the other floors are also open, which is a thermal bypass for air which should be sealed. The hot water supply piping and domestic hot water piping is not insulated in this basement space. This open louver could be used as an exhaust duct for rest room ventilation.

The recommendation for this basement foundation area is to have a 2# high density, urethane foam sprayed from the first floor sub floor and down the walls to the concrete floor. A nominal three inches would give about an R-20 insulation plane and seal the pipe risers, air vents and masonry wall to concrete interface. Be sure that the foam meets current fire barrier ratings and is high density to limit moisture adsorption.

First Floor: front entry way door has had a commercial metal framed door and window added as a storm door/airlock entry. This entry is small and not handicapped accessible, but a ground level rear door is available for access to the first floor offices. No handicap access is available to the second floor, as only one stairwell services the building. The upper glass panel in the metal framed door is missing its top cross channel to seal and hold the glass into the door frame. The door also does not seal evenly around the metal frame. The original wood entry door is oversized and the weather stripping and sweep should be replaced. Inside the building, on the wall under the alarm panel some conduit and wire mould path ways are open and should be closed off with fire stop caulk. At the ground floor entrances the exterior surface has been refinished and some of the building wood trim work is in contact with the soil, providing a path for moisture and insect entry to the building.



North Side of building adjacent to the County Court House

Note: Glass block windows in stairwell, replaced awning windows on NE end.

The central hall has two replaced wall mounted hot water convector heaters, one at the entrance door and a second wall mounted unit under the stairway. These commercial units do not have insulation on the hot water piping which should be insulated along with the rest of the heating pipes in the basement.

The women's/handicapped restroom on the first floor has an unusual floor plan with two toilets and lavatories, one in the larger room with the access door and another in a small three foot by ten foot stall with full door off the larger room. Staff comments are that this space is cold in the winter, and since we have two small rooms on a corner of an insulated building, with two large oversize double hung windows and a cold basement below is very believable. The larger space with high ceilings and large window has a three foot section of baseboard with a TRV, and the adjacent stall room has an eight foot section of baseboard radiator, but the piping below has been modified and added to and may not be delivering enough hot water flow to these units.

East side of building with back door and chimney for the oil fired Boiler. T he South side faces the alley, note replaced awning windows and four window air conditioning units in windows.

Air Conditioning: The building has six window air conditioners for spot cooling of office area. This method of cooling is not the most energy efficient and has a negative impact on the buildings historical look. The upgrade solution would be to install ductless split air conditioning units or variable refrigerant flow (VRF) with the condenser located outside, between buildings and wall mounted evaporator units locally controlled in each office space. One of the south side A/C units is supported on an external steel framework that is an eyesore and not historically accurate. In defense of the current window mounted units, they all appear to have been replaced with models that are up to date regarding energy efficiency in window units. Split ductless systems are about 3 times more energy efficient, and this climate zone requires limited air conditioning but this is an exceptionally warm summer.

Third Floor: there is access to the third floor via the central stairway. The third floor consists of two storage rooms, one in the west facing front of the building, with a half round historic window used for storage space. This space has the boxed in ceiling of the stairwell and is unfinished with raw brick/block walls and drywall/sheetrock on the sloped ceiling areas. Above the ceiling is fiberglass insulation, with no access hatch (I estimate it to be 6 inches of a fiberglass bat) to inspect. This space also is heated via baseboard convectors. The Blower door test showed it to be very leaky and a thermal bypass for air to travel up from the basement and lower levels to the attic. The air travels up the old pipe chases that were used for both steam pipes and now hot water piping. In addition it escapes up the open to the room stair wall area and stairwell ceiling box area**. Blower Door results for this space alone was 4600cfm50.**

This heated air can then travel up into the attic space above the ceiling, due to the unfinished drywall seams of the ceiling plane to the masonry walls.

My recommendation would be to air seal these thermal bypass pathways to cut air flow though the building and establish the air and thermal boundary as the knee walls and ceiling plane. The ceiling would benefit from upgraded insulation, which could be accomplished either by removing the drywall and existing insulation, upgrading with blown in cellulose, insulating poly isocyanurate foam sheathing and drywall. The insulated walls could be insulated with spray foam or foam board. The historic single pane round top window which does open for air flow, but does not have any air intake, unless the door to the stairway is open, would benefit from a storm window both for energy efficiency and preservation.

The east facing or back storage room is finished to a higher level with finished drywall/plaster ceiling, but has two outboard under the eve storage closets that are also heated and has unfinished drywall allowing air flow from levels below to take this thermal bypass. Hot water piping for the baseboard convectors travel through these spaces, including some element and cover is one of the storage closets. Heating these areas is of no value to the occupants or the building, and the piping should be insulated. These storage closets need to be treating in the same manner as the front storage room with air sealing and insulation. This is a good application for spray foam, where a fire rated 2# high density foam could be sprayed both on the walls and ceiling which will both insulate and air seal. Prep work would be to move some of the hot water piping away from the wall to allow both future access to the piping and room for insulation.

Blower door testing of this room, showed considerable less air travel leakage than the front unfinished storage room. With the door to the outboard storage room closed, **blower door testing was 1650cfm50**

and with both the doors open it was 3510cmf50. That shows how much the airflow and heat loss could be reduced with air sealing in the spaces under the eves.

This rear storage area also has a pair of original double hung windows and a wall mounted fan that hopefully is not used, due to its age it would be both inefficient regards energy consumption and electrical safety. My recommendation would be to remove it or replace it with a modern fan and safety controls to turn it off is there was a fire.

The ceiling and wall area adjacent to the exterior chimney show evidence of moisture damage, probably from the chimney flashing which should be corrected. The escape of heat from the adjacent heated storage rooms could also have an effect on this area, effecting the freeze and thaw cycles during the winter.

Blower door testing was preformed on various sections of the building, to get baseline information and see if there are gross leakage areas that can be found and corrected. Spaces are typically depressurized to -50 Pascal's, which Is about equal to a 20 MPH wind on all sides of the building .Results are expressed as cubic feet airflow (CFM) at testing pressure.

Basement: 1330cfm34

The basement was difficult to test, as it did not have any direct outside access. The lack of being able to get a lower pressure than -34pa was due to the basement being open to the outside via the ventilation louvers and other penetrations.

First Floor: 2660cfm50

The first floor was tested at the east parking lot door and no major bypass areas were detected. During the test doors to offices and hall were opened and closed to determine changes in air flow. Air conditions were not removed from windows for this test and they do increase the air leakage numbers but are a minor contribution to figures.

One curious spot did show up and confirmed my visual examination that the wooden frames of the original double hung windows did not look like they were caulked and sealed to the masonry framework. Under negative Blower Door test conditions, leakage could be felt around these openings. They would benefit from caulking properly applied inside and outside.

Second Floor: 2432cfm50

The second floor was tested from the stairwell fire door off the hallway. Some air conditioning units are installed in windows which does increase the air leakage rate.

The Blower Door results are then converted in Air Changes/Hour at natural draft conditions.

The 1st and 2nd floor areas are about 0.57ACHnat, which is the median leakage rate for an existing building. The 3rd floor comes out to be much higher, with 2.4ACHnat which indicates a very high rate of leakage under natural draft conditions**. The entire building is estimated to have an air change rate of 0.98ACHnat of which anything above 0.80 is typical for the construction in this era.**

Infrared Thermal Imaging: the high temperatures we have had this summer have not allowed us the luxury of a through inspection with the FLIR infrared equipment. I would be pleased to return at no additional expense and do an Infrared Survey with the facilities manager, We typically would like a differential temperature of 5F with the Blower Door or 18F without the blower door but his masonry building has quite a bit of thermal mass and temperature inertia and needs some cooler weather to show up additional thermal deficiencies.

Lighting for this building has changed little since it was built in 1948 with 11 bare incandescent bulbs in the basement and entry hallway and ceiling surface mounted florescent fixtures.

The basement is only used for service functions, so these bulbs are not a large energy consumer, but they could be easily switched to CFL's. Most offices, hallways and spaces have ceiling surface mounted florescent fixtures, of which many have been upgraded to T-8 green end bulbs. The two exit light fixtures are of recent vintage, and new LED exit lights are becoming standard.

The areas that should have updated lighting are the entrance hallway, which has 2 incandescent fixtures, with a burned out bulb and no diffusing cover. The adjacent stairway, which has a north facing six by ten foot glass block wall, has only one ceiling mounted bulbs of 75 watts. This classic hanging fixture could be reworked to have 3 or 4 CFL's providing better lighting and safety when it is overcast or dark outside. It also could be replaced or supplemented with wall mounted sconce style lighting. Several of the glass blocks are cracked, and they can be patched or replaced if they are show to have lost insulating value.

The first floor bath is illuminated by two large double hung windows, but the overhead fixture may provide general room lighting and the sink area would benefit from task lighting. An occupancy sensor would also be a good addition in this room.

Only one office has task lighting, and for office work task lighting could be helpful. There are now efficient desk lights available.

Windows: for most of the building, the original large double hung windows are still functional and all but one (NW first floor which appears to have been fitted in the past with a plastic storm window taped to the wall) has triple track storm windows. They should be properly fitted with weather strip, and their frames caulked. Triple track storm windows with the existing double hang windows offer better energy efficiency than replacing the assembly with a modern thermo pane insulated window. As window technology is improved and prices hopefully are reduced, the windows could be replaced, but it is not my recommendation to do so at this time.

The two steel casement windows, one in the basement stairwell and the other in the men's room off the stairwell landing need to be replaced with modern windows. They show the effects of moisture, due to condensation on the plaster and surrounding wall area.

The east facing side of the building had windows, high up on the wall for light and ventilation, which have been replaced with framework and insulated glass awning style windows. They appear to be in good condition and will have a longer service life than the double hung windows. There are metal brackets attached to the brick outside wall, which I assume were part of the opening mechanisms for the old windows, which are no longer being used and can be removed.

Some of the window exterior trim paint appears to be chalking and staining the brick on the building, indicating the end of its useful life and that it should be repainted.

The office copier a Savin 8055 does have an "energy saver" feature.

Utility bills: a review of the utility bills shows a fuel oil consumption of around 1800 gals. Per year and if the recommendations of insulation and sealing work are completed, you could expect to see a reduction of about 25% to 30%. That would be around 600 gallons of fuel oil per year, or around $1800 at current heating oils costs.

The electrical consumption is constant at around $200/month, in the range of about 1000KWH.

Electric water heating costs run about $25/month, of which a majority percentage is due to heat loss, from the older tank and uninsulated hot water piping. The hot water usage is mostly for hand washing and a new foam insulated hot water tank and insulated piping would reduce this energy usage.

Recommendations:

1) **Insulate and air seal the perimeter of the building in the basement with spray foam.**
2) **Insulate and air seal the 3rd floor spaces.**
3) **Replace 2 steel casement windows**
4) **Upgrade lighting in entrance, restrooms and stairwell**
5) **Consider replacement of heating system with LP condensating boiler**
6) **Consider distribution upgrades of hot water heating, piping and insulation**
7) **Repair flashing leak around chimney**
8) **flue pipe repair in outside chimney entrance**